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Data Visualisation and Decision Making Solutions to Forecast and Manage Complex Urban Challenges STAKEHOLDER EVALUATION REPORT

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D5.3 STAKEHOLDER EVALUATION REPORT

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1 INTRODUCTION

1.1 STAKEHOLDER EVALUATION REPORT

Decision-making based on large amounts of data and different data sources constitutes a growing challenge for many actors in society. An increased flow of information from social media and open data sources means that decentralized decision-makers such as regions, municipalities and cities are forced to change, adapt, and modify their existing decision-making (Voight & Bright 2016). What is the current status of European cities and municipalities? How do municipalities and cities in Europe work with data-driven decision-making today? What are the future opportunities and challenges? This report provides an overview and examples of how different organisations in the European cities of Malmö, Copenhagen, Oxford, Manchester and Vienna work with and relate to possibilities, challenges and limitations of data-driven decision making. Furthermore, the report presents different views of urban stakeholders' on data-driven decision making and how they relate to concepts of open data, big data, social media data and visualization.

1.2 PURPOSE

The purpose of this report is to outline current strategies and main points on how data is used in decision making in selected European Cities and to evaluate the current state and possible outlooks for data-driven decision making. The selected cities are either city partners in the UrbanData2Decide consortium or cities which collaborate closely with universities and institutes involved in the consortium.

1.3 TARGET AUDIENCE

This report is primarily meant to be read by officials working within state or municipal organisations. The report is related to previous reports and references published for the UrbanData2Decide research project and the result reflects possible uses and applications for concepts developed in previous case studies (See for example Neuschmid et al. 2015; Dittrich et al. 2015; Voight & Bright 2016).

2 CONCEPTS

2.1 DATA DRIVEN DECISION MAKING

Decisions are made in organisations every day and the basis for decision can vary depending on the kind of decision made. Some decisions can be made based on intuition or expertise among decision makers, but major decisions usually require analysis of data. This can be referred to as data driven decision making (Provost and Fawcett 2013; Brynjolfsson, Hitt and Kim 2011). Data driven decision making can be employed for different purposes in different organisations. Data driven decision making can, for example, be leveraged to discover opportunities or issues based on data, to use further as a basis for decision. It could also be leveraged to automate decisions or repeat decisions if a specific threshold is reached in the data (Provost and Fawcett 2013).¹ Data driven decision making can therefore not be described as a single method, as it is a mix of methods that can be applied in different contexts for different purposes.

2.2 BIG DATA, SOCIAL MEDIA DATA AND OPEN DATA

Data has become more available as result of the technological advances the last decades. Data is today generated by organisations and citizens both voluntary and non-voluntary through computers, sensors, smartphones etc. (Dumbill 2013). The concept Big Data was introduced in the late 90's to address the issue on data which size was too big to fit on a local hard disk. The concept has since then grown in both importance and attention as data sources has increased in size, speed and numbers (Provost and Fawcett 2013). An exact definition of Big Data is however hard to come across. Various definition exists, but most researchers seem to agree that it cannot only be defined by data volume, but also by data variety and data velocity. This is generally referred to as the three Vs: *volume* for the increased size of data; *variety* for the increased diversity of sources; and *velocity* for the increased speed at which data is generated (Rossum 2011).

Related to the concept of Big Data are the concepts of Social Media Data and Open Data. In general, data from social media are user generated, while open data refers to data free to use, reuse and redistribute for anyone (see Bright et al. 2015). Both social media data and open data are significant sources in Big Data, meaning that the variety of sources used in Big Data includes both social media data and open data. It is therefore important to think of big data, social media data and open data as related and integrated concepts.

¹ For examples on how data driven decision making can be employed, see Ddamba & Dittrich, (2015).

3 METHODOLOGY

3.1 INTERVIEWS

Semi-structured interviews (Longhurst et al. 2006; Valentine et al. 2005) were conducted in 2016 between June and October by UrbanData2Decides' national research teams. Each interview was recorded after asking for consent by the respondent and notes were also taken by the interviewer. Almost all interviews were conducted in the respondents' native language.

Each interview was divided into two parts; a part where current practices on how data was used in the organisation were outlined and a part where possible practices for more data driven decisions were explored (see annex 2 for the interview structure and questions). The structure of the interview and different themes for discussion was explained for the respondent before the interview.

The same interview questions were used for all interviews in all cities. The semi-structured form did however allow the interviewer to ask follow up questions, as well as the respondent to develop ideas and thoughts (Longhurst 2006; Valentine 2005). Some variations did therefore occur in the questions and themes explored.

3.2 RESPONDENTS

To outline stakeholders' view on data-driven decision making, and how data is used in decision making, key informants were chosen as respondents for the semi-structured interviews. The key informants were selected based on their position and expertise on data within their respective organisation (Longhurst 2006; Valentine 2005). All key informants are involved in decision making processes on a daily basis, and therefore have deeper knowledge on how data currently is used and how it potentially could be used to make more founded decisions. The key informants in the different cities are described in the following sections.

3.2.1 MALMÖ, SWEDEN

In Malmö two key informants from the City Planning office in Malmö Municipality were interviewed.

- **Respondent 1:** *GIS analyst and former head of IT*
Respondent 1 is currently employed as a GIS analyst but has previously been employed as the head of IT at the City Planning office. As a GIS analyst the respondent is responsible to collect, process and analyse geographical data for decision making processes. The respondent is also responsible for the development and maintenance of web based, mapping applications and related databases.
- **Respondent 2:** *Head of communications*
Respondent 2 is currently employed as the head of communications at the City Planning office. As the head of communications the respondent is responsible for communication issues both internally and externally in the City. This responsibility includes social media communications, public relations and collaborations inside and outside the organisation.

3.2.2 COPENHAGEN, DENMARK

In Copenhagen the Head of City Data Unit, Environmental and Technical Administration was interviewed. The City Data Unit is collecting different kinds of data from the administrations within the city, consolidating them and advancing them to both Open Data and internally to support other units and administrations of Copenhagen municipality.

3.2.3 OXFORD, ENGLAND

In Oxford one key informant from Oxford City Council was interviewed. The Respondent was up until recently the head of social research at Oxford City Council. This gave him a wide ranging responsibility for the collection, analysis and dissemination of statistics relating to the municipality. In particular, he and his team are responsible for maintaining frequently used statistical measures, and also responsible for answering ad-hoc queries and data requests from other city officials.

3.2.4 TRAFFORD, ENGLAND

In Trafford, the head of the Trafford Innovation and Intelligence Lab was interviewed. Having worked in the council for more than 15 years previous to leading the Innovation and Intelligence Lab, the head is responsible for growing and improving Trafford Council's use of data. In this role, he leads the expansion of the Lab's technological portfolio, identifies new options to include data analytics into the Council's operations, and works to bridge the gap between data analysts, subject matter experts, and policy makers.

3.2.5 VIENNA, AUSTRIA

In Vienna two key informants from the municipality of Vienna were interviewed.

- **Respondent 1:** Spokeswoman of OGD (Open Government Data) Vienna, employee at the municipality of Vienna within the information and communication technologies department; coordinator of the open government competence centre. Areas of work include amongst others: ICT-Strategy, e-government, and spokesperson of cooperation Open Government Data Austria.
- **Respondent 2:** Director IT-management, employee municipality of Vienna. Areas of work include amongst others: IT-controlling, IT management and consolidation.

3.3 INTERPRETATION AND CODING

The results from the interviews were transcribed by each national research team and combined with the notes taken during the interview. The transcribed interviews were then interpreted and coded into categories based on the content of the interview (Cope 2010). Since some variations occurred in the questions and themes explored, the categories used for coding were not the same for all interviews. The interpretation and coding was therefore conducted by the same research team that conducted the interview.

The coding of each interview was conducted as an open coding (Cope 2010). The purpose of the open coding was to make sense of the collected material and structure it according to the overall purpose of this report. As the interviews were conducted specifically for this report, most of the material already reflected the overall purpose. Once the open coding had been performed, each code was assigned to a specific theme and interpreted in that context. Each theme is presented as a subsection in section 4.

4 ANALYSIS

4.1 MALMÖ, SWEDEN

4.1.1 DATA USAGE IN DECISION MAKING

4.1.1.1 Organisation

The City Planning office in Malmö has the overall responsibility for planning and construction in the municipality and decision making processes are usually related to spatial planning, land supply, building permits and supervision of construction work. The office is governed by the City Planning committee which consists of nine elected politicians as decision makers. The officials working at the City Planning office are responsible to investigate, prepare and submit proposals based on their expertise to the City Planning committee, who makes the final decisions.

In 2015 and 2016 the organisation of the City Planning office has experienced a lot of stress. A high influx of immigrants and other citizens to Malmö has forced the City Planning office to take on new responsibilities related to critical issues such as the housing shortage that has followed the influx of migrants. This situation has created an urgent need for more and faster processed information within the organisation.

4.1.1.2 Decision making processes

Decision making processes at the City Planning office are initiated and decided by politicians, but carried out by officials. Thus, a large part of the officials' mission is to ensure that proposals submitted to the City Planning committee are well prepared based on the needs of the decision making. Officials therefore need to act as knowledge brokers to support different parts of the processes with information and expertise when necessary. As a part of this mission officials are also responsible for developing methods and assure the quality of the data used in decision making.

In decision making processes citizens also have to be involved. According to the Plan and Building Act (SFS 2010:900) issues related to planning and construction always have to take general and individual interests into account. Opinions on planned constructions therefore have to be collected from citizens for each proposal submitted to the City Planning committee. Usually opinions are collected through interaction dialogues between officials' and citizens, but opinions are also collected by questionnaires or by telephone interviews, and treated as public documents according to the Public Access to Information and Secrecy Act (SFS 2009:400) (see subsection 4.1.1.5 for more information).

4.1.1.3 Types of data and data processing

As the need for more information in the City Planning office has increased, data has also become increasingly important in decision making. Previously data was also used, but decision making was not driven by data and data analysis. Instead planning and decision making was most of the times based on expected needs, meaning

that if for instance a planned neighbourhood would consist of family houses, there would also be a need for a pre-school and an elementary school. Today data is used more extensively to improve decision making. Instead of looking for needs, data is used to find needs. If the data indicates that a neighbourhood experiences an influx of families with children, the need for a pre-school or elementary would be investigated. The use of data has therefore become more important, both for officials and decision makers in the City Planning office.

Although an increased use of data in decision making, the type of data sources haven't changed significantly in the City Planning office. The main source of data is population data. The population data is collected by consulting firms from the Swedish Tax Agencies population registry and processed and combined with property data from the building registry by officials at the City Planning office. Once processed and combined the data includes variables on socioeconomic status, educational level, marital status, housing conditions etc. for each property in the municipality. This data offers the City Planning offices a satisfactory basis for decision in most decision making processes.

In addition to the population data and the property data the City Planning office also collects public opinions data. In subsection 4.1.1.2 it was described that according to the Plan and Building Act (SFS 2010:900) the City Planning office has to collect opinions on planned constructions. Social media data is used to some degree in these processes, but usually opinions are not collected from social media. Social media is rather used as a tool to communicate and inform citizens on interaction meetings, ongoing decision making processes and current decisions. Instead, opinions are collected through interaction dialogues, questionnaires or telephone interviews and later processed manually by officials.

The processing of the data retrieved from the consulting firms and the building registry is automated using a data integration software. The software is called FME (Feature Manipulation Engine) and has been developed by Safe². FME allows officials with expertise to process large datasets collected from several sources, in different formats, to create new outputs designed to fit the needs of the decision making process. FME ensures that the data quality remains high throughout the whole process by using workflow models, minimizing the human involvement. The City Planning office has, however, not connected FME to external data sources or other data streams, and the task to choose which data to process is therefore manual. The predetermined models and workflows do however ensure that quality of the data is not dependent on a particular person, but a function, and the quality will remain the same even if a person with responsibilities to run FME and process population data leaves the organisation.

4.1.1.4 Data accessibility and visualizations

To distribute and visualize data in an easier way for all officials, attempts have been made to develop a common user interface. Currently an application named *Koll* is in use. *Koll* is based on the business

² See Safes' official website for more information: <https://www.safe.com>

intelligence and data visualization software QlikView, developed by Qlik³. *Koll* makes it possible to distribute and visualize large datasets from several databases at the same time in a web based user interface. Although *Koll* has been implemented in the City Planning office, and the organisation as a whole, it is not used at any greater extent. Some administrations use it for regular tasks, but the City Planning office lacks the knowledge of how to use it and therefore does not use it. Instead distribution and visualization of data is made by requests, which cause the City Planning office to be dependent on the persons who have the skills and the knowledge to process and analyse data. This also causes problems in the organisation, as data is not available and shared between different administrations on a regular basis.

4.1.1.5 Policies, laws and regulations

Several laws and regulations on data protection and privacy restrict and support how the City Planning office processes and handles data. Restriction are mainly applied to how data can be processed and analysed without risking the personal integrity of the citizens, which is regulated in the Personal Data Act (SFS 1998:204) based on the EC Directive 95/46/EC on data protection. However, the respondents at the City Planning office rarely experience the regulation as a limitation, but rather as support. By referring to the law, it is easier to motivate why some data shouldn't be shared either to organisations outside the municipality or to the public. This gives the City Planning office control of their data and how it should be used.

Besides the Personal Data Act the City Planning office also have to relate to the Public Access to Information and Secrecy Act (SFS 2009:400). This act ensures that the public and the mass media are entitled to receive information about state and municipal activities. Unless a document is considered to be a working document or sensitive enough to be classified, it should be made available to the public. This also includes documents and opinions sent to, or collected by, the City Planning office. Opinions collected on planned construction from citizens therefore have to be registered as public documents if they are submitted in written form. This can create a large amount of work and has caused the City Planning Office to reduce the number of chances and forums where the public can send in opinions on proposed plans and constructions.

4.1.2 OPPORTUNITIES, LIMITATIONS AND CHALLENGES IN DATA-DRIVEN DECISION MAKING

4.1.2.1 Current organisation

The responsibility for planning and construction requires the City Planning office to constantly adapt to current needs and requirements. Thus, the increased need for more information and faster access is probably not a passing trend. Knowledge on how to handle and use new, and current, information sources is therefore necessary according to the respondents. In many cases the City Planning office is dependent on consulting firms and knowledge within the organisation is usually attributed to specific individuals. This causes decision making to be dependent on the expertise of consulting firms and officials, and decision makers tends to trust

³ See Qlik's official website for more information: <http://www.qlik.com/>

officials that are experts on data more than actual information derived from the data, according to the respondents. More knowledge on how to handle and process data within the organisation is therefore necessary to gain better control of data-driven decision making processes.

4.1.2.2 Decision making processes

As described in subsection 4.1.1.2 data is used more extensively today in the City Planning office to improve decision making. To use faster and bigger data sources would however possess a challenge due to the pace of the decision making according to the respondents. The decision making processes engaged by the City Planning office are usually long-lasting, as most democratic processes are. This is meant to ensure that no decisions are made based on current trends, but also to ensure that all general and individual interests have been taken into account. But to include bigger and faster volumes of data would therefore also be limited according to the respondents. Data collected continuously in a fast pace, such as Big Data, would, for example, be difficult to act on due to the slow pace of the decision making process. A challenge is therefore how to include bigger and faster volumes of data in decision making processes without compromising the pace and opportunities to share opinions.

4.1.2.3 Types of data and data processing

As discussed above, a challenge for the City Planning office will be how to include bigger and faster volumes of data in their decisions making processes. But the challenge is not only limited to how to integrate data in decision making processes; it also comprises how to handle and process the data. More data on opinions from the public could, for instance, be collected through applications on social media, but it would also require the City Planning office to handle and process that data. This would not only cost money, but also time, and depending on how data on opinions are collected, the City Planning office could be bound by law to register these opinions as public documents. To employ new sources of data could therefore constitute a large amount of responsibilities that would make the cost of employing the data to high according to the respondents.

The respondents also believe that employing new data sources, such as Social Media data and Open Source data, would increase the risk of producing data with poor quality. This has mainly to do with a lack of trust for these types of data sources, and not how the data is processed or could be processed. The respondents therefore don't want to redistribute data from these types of data sources, since they want to maintain a consistent quality and trustworthiness in the data they redistribute, which they don't believe the Social Media data and Open data to have. This does not however mean that Social Media data and Open data aren't used in decision making processes at the City Planning Office. Social Media data and Open data are used, but rather as indicators than actual bases for decisions.

4.1.2.4 Data accessibility and visualizations

To promote more data-driven decision making processes data has to become more accessible in the organisation as whole. As the technical infrastructure already exists, the challenge is not how to share and make data available, but rather how to leverage and use it. The respondents believe this could create a lot of benefits, but it would require the organisation to increase the knowledge on how to use and employ data in decision making processes, knowledge which is limited to some officials and politicians today.

Another important part in making data more accessible is how to present it. As data flows increase in both speed and volume there is a need to present data in smart visualizations to make it more accessible. Visualization would make the data more understandable and easier to interpret, and therefore also easier to distribute. The technical infrastructure to create data visualizations also already exists in the organisation; the challenge is therefore how to increase the knowledge on how to use these tools to visualize data.

4.1.2.5 Policies, laws and regulations

Since the respondents rarely experiences any of the regulations as limitations, none of the respondents think that an increased use of data in decision making would be more limited by Swedish laws. But the respondents do think it is important that the public feels safe, that they can trust the City Planning office as an authority. An increased use of data in decision making processes would therefore need to be handled with care, to make sure that the public doesn't feel that the municipality misuses their trust. This is however complex, as some data used by the City Planning office is collected and retrieved by contractors. The City Planning office will therefore never have full control of all the data they use, and can therefore not guarantee that the data is handled in accordance to their own procedures.

To maintain full control of data is also challenging since the City Planning office is required by law to share public documents and data with the public and mass media according to the Public Access to Information and Secrecy Act. Once information or data is made public the City Planning office has no influence on how it's used. Information and data made public by the City Planning office according to the law can, and have, therefore been misused and misinterpreted by both the media and citizens. To include more data in decision making processes would therefore increase the risk of having more information and data made public, which could potentially be misused or misinterpreted if not used in the right way.

4.1.3 SUMMARY AND CONCLUSIONS – MALMÖ, SWEDEN

MALMÖ, SWEDEN	
Respondents:	
Respondent 1	GIS analytic and former head of IT
Respondent 2	Head of communications
Current organisation:	
Current situation	Organisation under pressure and in need of fast decisions. Need for knowledge on how to process and use more and faster information in decision making and other processes.
Limitations and challenges	Important to acquire more knowledge within the organisation and not to become dependent on consulting firms and gain better control of information.
Decision making processes:	
Current situation	Long lasting decision making processes to ensure that general and individual interests have been taken into account.
Limitations and challenges	Challenge to include faster data and Big Data sources without compromising the quality of the decision making procedure.
Types of data and data processing:	
Current situation	Main data sources are acquired by consulting firms from Swedish authorities and processed using predetermined models and workflows.
Limitations and challenges	Challenge to employ new data sources in decision making without making the cost too high due to laws on public access.
Types of data and data processing - Use of social media/social media data:	
Current situation	Currently leveraged as a tool to communicate and inform citizens on current decisions.
Limitations and challenges	A lack of trust on the quality of the data limits the use and redistribution of information collected on social media.
Data accessibility and visualizations:	
Current situation	Applications and technical infrastructure for visualization and redistribution of data are available but not used due lack of knowledge among employees.
Limitations and challenges	Challenge to increase the knowledge on how to visualize and redistribute data using applications and technical infrastructure already available.
Policies, laws and regulations:	
Current situation	Swedish laws on data protection, privacy and availability restrict and support how data is used in decision making.
Limitations and challenges	Challenge to increase the use of data and still maintain control to ensure that data doesn't get misused due to laws on public access.
Outlook and critical issues:	
Outlook	Possible to leverage data already available and employ new data sources by improving the knowledge of how to process and analyse data.
Critical issues	Difficult to employ more and faster data sources due to laws on public access and long-lasting decision making processes.

4.2 COPENHAGEN, DENMARK

4.2.1 DATA USAGE IN DECISION MAKING

4.2.1.1 Organisation

The City Data Unit is part of the Environmental and Technical Administration of Copenhagen municipality. The City Data Unit is collecting different kinds of data from the administrations within the city, consolidating them and advancing them to both Open Data and internally to support other units and administrations of Copenhagen municipality.

To this end the unit has built up technical infrastructures and tools. The unit is also in charge of the collection of live data about parking and traffic or tracking of issues like the reporting of defective equipment. The infrastructure allows them to easily publish data as open data to the public.

The unit also supports political processes e.g. the preparation of policies by providing specific data to the political organisation.

4.2.1.2 Decision making processes

First and foremost the data is used to support the day-to-day work of the municipal administration. The very exact maps are for example used to measure the sidewalks to invoice for street cleaning or to prepare tenders for cleaning facades from graffiti.

The unit is also responsible for collection and aggregation of data and supporting decision making and planning. A very prominent example is the unit that has developed a socio-economic map that shows different social indices – income, unemployment, non-western decent, size and quality of apartments – that has been used to identify disadvantaged areas. The socio-economic map has been used to underpin the policy for disadvantaged areas, the identification of neighbourhoods for urban renewal, and also e.g. for moving some of the very skilled kindergarten teachers to child care institutes in these areas. A current focus is on private and public housing; the prices for real estate have been rising in Copenhagen and there is a strong political focus to assure that e.g. policemen and nurses are able to afford living in the city.

In special circumstances, specific data is collected and used for evidence-based decision making later on: For this purpose data has been collected before and after e.g. the creation or renovation of a green area.

The provisioning of as much of the data as open data has been a conscious decision to also support transparency and democratic engagement of citizens. By providing the data used for administration and decision making interested citizens can explore the data themselves and contribute to the discussions on a more informed level.

4.2.1.3 Types of data and data processing

The basic data provided is based on the cadaster information. This is the basis for a number of other data sets that supports the maintenance of the city: the placement of signs or trees for example.

More dynamic data is collected, for instance traffic data, parking data, air pollution data, which comes on a more minute-to-minute basis and provided for the public as well. Likewise information from other parts of the administration is collected and provided both internally and for the public, like waiting lists for the kindergartens, which books are lent out in the last day. “Every data that is available is interesting to [...] put out as open data” (Head of City Data Unit).

4.2.1.4 Data accessibility and visualizations

The central issue to promote the usage of data is to make it accessible and to provide tools to visualise and interact with the data. As much of the data is geographical data, map based visualisations are central. “The maps can explain various very complex things in one page. Nothing else can do that. To raise questions and engage people, which is tough in other areas, and if you don’t have a map.” (Head of City Data Unit).

Other data is displayed publicly or on internal dashboards. Data about number of cyclists, or current level of pollution is e.g. displayed at central places in the city. Managers of different units have access to dashboards about HR data, e.g. sickness, salaries and so on.

4.2.1.5 Policies, laws and regulations

The City Data Unit is very much aware about the Data Protection Act and related directives. The awareness in the whole organisation was sharpened by a debate when the administration tried to implement a traffic tracking system. Though anonymized, the data could be used to filter out an individual’s movement if a number of touchpoints were known. Answering this, a privacy panel was established, where experts with insight in privacy issues assist the administrations in matters relating to privacy.

4.2.2 OPPURTUNITIES, LIMITATIONS AND CHALLENGES IN DATA-DRIVEN DECISION MAKING

4.2.2.1 Current organisation

The movement towards an evidence based decision-making is expected to continue. The City Data Unit is therefore engaged in several strategic projects, both on a national level and exploring new possibilities.

Together with the other four biggest cities in Denmark, Copenhagen municipality founded an organisation in order to create a national portal where data is provided on a national level. This portal is part of the national digitalization strategy and the local authorities’ digitalization strategy.

In the City Data Exchange project, Copenhagen municipality and the regional administration are part of developing a sales platform where companies can sell and buy data. The idea is to open up for business opportunities based on relating e.g. energy data and sales data in supermarkets.

4.2.2.2 Decision making processes

Central opportunities are seen in the areas of transparency of the administration and in the area of data based and evidence based decision making.

Publishing the data decisions are based on allows for a more informed debate. Citizens have a base to put forward more informed questions in the debates and therefore the democratic decision making and participation processes can be of a higher quality. This of course also requires that the data is more complete and accessible. Otherwise, publishing the data would create additional work to answer data related questions.

Another potential is to deepen and broaden the data and with it the knowledge on which to base decisions and inform planning. “When we create a small park, what does it do, to the housing prices, the health, the mobility, sales in the local store, whatever?” (Head of City Data Unit). Today a specific set of indicators (provided through the socio-economic map) is used also to measure improvements. One could maybe discuss to develop other aspects, e.g. political engagement or economic growth, if a better understanding of how different indicators related to each other could be developed.

As central limitations, understanding and skills of the members of the administration are highlighted. The City Data Unit has been instrumental to promote the use of data in the administration. Many people are well able to understand what can be done, what visualisations can be developed. However, often the step to really use the data and to make it part of the own practice is difficult.

This is partly ascribed to the lack of skills, both on the shop floor level and on a management and strategic level: What does it mean to relate what you do to the analysis of data.

4.2.2.3 Types of data and data processing

Mainly the use of more data and more complex algorithms is regarded as opening up possibilities for a more differentiated evidence and data-based decision making.

Challenges are mainly seen when including data from social media data in the decision making. How should e.g. a shit storm, i.e. a highly controversial topic being actively discussed on social media, be taken into account and handled? How significant is the social media discussion compared with a citizen panel, the results of a hearing or face-to-face engagement?

4.2.2.4 Data accessibility and visualizations

One of the main potentials is seen in the broadening of the data base, both to underpin decisions as well as to understand the effects of changes to the environment. To this end Copenhagen Municipality is part of a project to develop a ‘City Data Exchange’. The idea is to invite companies to share business data for a fee. The challenge here is to assure that e.g. a direct competitor is not getting insights that can be used against the company providing the data. How can legal and technical mechanisms be provided to negotiate and control terms of usage of data.

4.2.2.5 Policies, laws and regulations

Besides the skills of how to make use of data and analytics, how privacy is understood and handled is seen as one of the central challenges: How can we allow citizens to provide access also to very personal data in order to support better administrative decision making? How can we provide technical and legal possibilities for individuals to share data in an informed and controlled way?

4.2.3 SUMMARY AND CONCLUSIONS – COPENHAGEN, DENMARK

COPENHAGEN, DENMARK	
Respondents:	
Respondent 1	Head of City Data Unit
Respondent 2	
Current organisation:	
Current situation	The City Data Unit develops infrastructures and tools provide data both internally and as Open Data. The unit is also involved in collecting, consolidating and promoting data for everyday administration, planning and strategic decision making
Limitations and challenges	Broadening the data available, both internally, but also on a national level and promoting exchange of business data.
Decision making processes:	
Current situation	The unit is supporting other units and political processes with data.
Limitations and challenges	Understanding and skills both on a shop floor, but also management and strategic level.
Types of data and data processing:	
Current situation	The policy is to promote as much as possible data as Open data.
Limitations and challenges	How to involve new data sources like social media data in the decision making processes?
Types of data and data processing - Use of social media/social media data:	
Current situation	Not used. The city has a citizen panel that is surveyed several times a year in order to get a representative picture of citizen's opinion.
Limitations and challenges	How to read social media data?
Data accessibility and visualizations:	
Current situation	The central visualisation is on maps and as tables.

Limitations and challenges	The City Data Unit is involved in a project to make business data available.
Policies, laws and regulations:	
Current situation	The City Data Unit is well aware of the legal regulations and committed to act in accordance.
Limitations and challenges	Legal regulations that allow both businesses and individual citizens to share data in a controlled way.
Outlook and critical issues:	
Outlook	Increasing the expertise in evidence and data-based decision making; broadening the base of available data.
Critical issues	Skills and understanding of potential data users; legal and technical means for controlled sharing of data.

4.3 OXFORD, ENGLAND

4.3.1 DATA USAGE IN DECISION MAKING

4.3.1.1 Organisation

Oxford City Council has overall responsibility for the provision of a variety of public services in Oxford, including organising recycling and waste provision, housing and planning applications, and certain leisure and culture activities.

As a historic city, Oxford faces a number of pressures in terms of managing infrastructure and managing the needs of a growing, mobile and highly multi-lingual population.

4.3.1.2 Decision making processes

Oxford council has three different types of decision making process which apply differently according to different areas.⁴ Some decisions are made by the full council, which consists of 48 elected representatives. Other decisions are executive responsibilities: i.e. they are choices made by the leader of the council. Decisions are often further delegated to individual committees. All decision making processes are governed by a constitution⁵.

4.3.1.3 Types of data and data processing

Oxford City Council already makes use of a variety of different data sources in their decision making. The majority of data being used are social statistics provided by external organisations. The Office for National Statistics is obviously a big provider in this regard; they produce the census, as well as a variety of annual sample surveys of the population and labour market. The Department for Communities and Local Government is another important source, especially the index they produce called the „Indices of Deprivation“, which is a measure of how deprived a given area is, and is often used to direct funding and spending. The National Health Service is another important provider, as they provide health data.

To a lesser extent, the council also makes use of its own data for decision making. For example, some pieces of work have been performed using benefits data to try and model and understand the impact of changes of central government benefits policy. Internal data is also used more frequently for performance monitoring.

4.3.1.4 Data accessibility and visualizations

One of the main responsibilities of the social research team is to facilitate access to data for people across the council. This is done in a reactive way, in the sense that the team will respond to questions in different areas and seek information on different subjects when asked. Some of this will be routine, responding to

⁴ https://www.oxford.gov.uk/info/20050/how_the_council_works/598/our_decision-making_process

⁵ <http://mycouncil.oxford.gov.uk/ecCatDisplay.aspx?sch=doc&cat=13443&path=0>

statistics which are often requested. At other times it can be more creative, as the team are asked to put together data on a novel area.

However, it also happens in a proactive way, in the sense that the team will try and push data out there and make people aware of it. One initiative worth highlighting in this regard is called „chart of the month“, where each month a new area of social statistics is chosen to be highlighted in an attractive visualisation.

The majority of visualisations used are static, used to tell a story related to particular strategies. However the council has also made use of interactive visualisations (the county council has several interactive visualisations). These can be useful both as a way of attracting the attention of decision makers and council members, and also the general public.

4.3.1.5 Policies, laws and regulations

Privacy and data protection legislation are an important consideration which structures work on social statistics, however also not one which occupies a too central position. Part of the reason for this is that much of the data which the council works with is produced by other organisations, such as the Office for National Statistics. The responsibility is hence with these organisations to ensure the data is already released in a privacy protecting way. It is also worth noting that the data protection officer is seen as a member of the IT team. Hence they have a clear motivation in terms of using data to enable things to happen (rather than a more legal perspective which might be more closed in terms of what data could be used for).

4.3.2 OPPURTUNITIES, LIMITATIONS AND CHALLENGES IN DATA-DRIVEN DECISION MAKING

4.3.2.1 Current Organisation

One of the major current limitations within the council concerns their access to data, and especially the extent to which that data remains up to date and relevant. One of the major tools for decision making remains the 2011 census, which clearly becomes more out of date with each passing year. This is especially important in the context of a city such as Oxford, which has a highly mobile population of which a significant proportion comes and goes each year. Hence there is significant interest within Oxford in terms of potentially making use of new sources of data.

4.3.2.2 Decision making processes

One of the major challenges and barriers to adoption of this type of data into decision making processes is however its veracity as a representation of the population at last. Governments, obviously, have an obligation to serve all citizens; and arguably they are more involved and active with the sections of the population which are the most deprived. However, these are the areas of the population who may be least likely to leave digital trace data: they may be less likely to use the internet, or to use social media, for instance. Hence there is a worry that, for example, using data from Twitter to infer population movement may result in biased decision making processes.

Here it is interesting to note that the possibilities for re-use of administrative data may be especially important. These data are typically quite well trusted, in the sense that they are also owned and operated by the council; they are also theoretically quite complete. Hence use of internally held stores of big data may be more important than externally held ones.

4.3.2.3 Types of data and data processing

There are also issues and challenges in terms of the types of data available. Social media data provide perspectives on networks and perspectives on opinions. These are arguably of some use to local government, but perhaps not as much as data on (for example) locations, or public service needs. Hence social media data especially often seems to not really fit into the local government service paradigm.

Another issue concerns available data processing skills within government. While there are skilled analysts within government, it is also hard to compete with the private sector when it comes to hiring skilled data scientists, which are still very much in short supply in the UK. Hence there is a need to build capacity in this area.

4.3.3 SUMMARY AND CONCLUSIONS – OXFORD, ENGLAND

OXFORD, ENGLAND	
Respondents:	
Respondent 1	Head of Social Research
Respondent 2	
Current organisation:	
Current situation	Organisation dealing with multiple overlapping challenges concerned with infrastructure renewal, shrinking budgets and growing, mobile population.
Limitations and challenges	Data required to make effective policy is often not available.
Decision making processes:	
Current situation	Well organised and codified decision making processes.
Limitations and challenges	Challenge would be to find a good way of integrating big data.
Types of data and data processing:	
Current situation	Mainly rely on data from third party organisations (typically other branches of government)
Limitations and challenges	Could make better use of internally held administrative data

Types of data and data processing - Use of social media/social media data:	
Current situation	Regarded more as a communication tool than an area where strategic knowledge about the city can be developed
Limitations and challenges	Worries about representativity of the data coming out of these sources
Data accessibility and visualizations:	
Current situation	Visualisations are used in lots of ways throughout existing work
Limitations and challenges	More could perhaps be done with interactive visualisations
Policies, laws and regulations:	
Current situation	Data protection directive is important but doesn't have a huge impact on work, as much data is produced by third party organisations.
Limitations and challenges	This might change as administrative data re-use becomes more important
Outlook and critical issues:	
Outlook	Time of innovation in local government with lots of possibilities to make better use of administrative data
Critical issues	Accuracy and trustworthiness of the new data being employed, and moving from proof-of-concept to implementation

4.4 TRAFFORD, ENGLAND

4.4.1 DATA USAGE IN DECISION MAKING

4.4.1.1 Organisation

The Trafford Innovation and Intelligence Lab has been set up in 2014 as Trafford Council's cross-organisational, multi-discipline data lab. The lab's core mission is to improve decision making, policy implementation and service delivery based on data; to achieve this, the lab brings together data and data/information specialists from the various organisations that work in Trafford, to work on particular problems. The lab currently consists of five employees and is working together with other specialists from other council departments and units on a project basis.

While operating based on agile and rapid iterative development principles, the lab's strategical approach is to co-locate data and people from a variety of origins and domains around specific improvement areas.

Since its inception, the lab has been working on a variety of projects to extend its portfolio⁶. Broadly, these fall into the categories of public health, crime and policing, demographic change, unemployment and economic inclusion. In this work, the lab pursues four main objects:

- Helping to reduce demand on services;
- helping to redesign services;
- Improving people's (citizens, 3rd sector, private, public) awareness and understanding of the local area;
- Helping to attract or retain investment into the Borough.

4.4.1.2 Decision making processes

As a cross-organisational lab and service unit, the Trafford Innovation and Intelligence Lab is not directly and formally involved in council decision making. Nevertheless, through its activities in data integration, processing, and analytics, the lab supports functions which are crucial to arrive at more informed decisions across Trafford council.

After an initial phase where the lab itself picked up themes and topics to work through with other council units, the lab is now being approached by these and other units to work on selected projects and, specifically, related data acquisition, processing and analytics. For Trafford's daily efforts to become a more data-driven council, this reflects an important cultural change: In less than two years, the council has established an organisational environment, where units and people are actively engaging with and seeking to use data in

⁶ <http://www.infotrafford.org.uk/lab/portfolio>

their decision making processes. The mere existence of the Trafford Innovation and Intelligence Lab as a dedicated support unit for other council departments and units is of basic importance for this change. Its accessibility means that units who are missing analytical or technological skills can easily access these, thus lowering the hurdles to implement projects for data-driven decision making – and increasing their chances of success.

Based on this initial success, Trafford has recently established a cross-council task force to further improve and structure needs assessments as well as policy implementation and service delivery. The task force provides the lab with all the council's data based evidence with regards to the needs of a specific part of the city (this can e.g. relate to building new, affordable houses, or looking at potential new schools). The goal of this work is to base decision making on a variety of council issues on proper evidence - which the lab team are compiling into easily understandable formats which can then drive decision making.

In this process, data analytics however does not directly influence decision making. Rather, it builds the initial evidence base which is needed to inform a decision making process. Depending on formal decision making requirements, this may be followed by public consultations and several iterations to develop solutions for a specific policy problem or service challenge.

4.4.1.3 Types of data and data processing

As indicated in the previous sections, data usage and processing needs have recently grown substantially in Trafford. Across the council, previously existing modes of decision-making and service delivery, which were often based on a limited use of isolated data and implicit assumptions about people's needs are now being transformed through an increased use of data, e.g. to better understand where new defibrillators should be installed in the borough.

Accordingly, the unit harvests and uses a variety of data, e.g. social care data, reports of broken street lights, data on benefits to understand which benefits people receive (e.g. as job seeking benefits, low income, or health-related benefits), crime and health data as well as environmental data (e.g. river level data). This data is only partly generated by the council or subsidiary bodies; additional data comes from the council's partners as well other open data (e.g. in the case of environmental data).

At this stage, most data used by the lab is open data or data sourced from public sector bodies. Social media data, even though it is accessible in some cases, does not play a major role in the unit's data analysis. Particularly the inherent self-selection bias and the resulting low representativity of such data currently prevent it from being used as a basis for decision making in Trafford.

Similarly, advanced implementations of Natural Language Processing to better detect community needs and sentiments are currently discussed, but not implemented. If combined with organisational restructuring efforts across the council, it is however expected that these systems could unlock substantial savings.

4.4.1.4 Data accessibility and visualizations

For the Trafford Innovation and Intelligence Lab, map-based, spatial data visualisations are the most essential output. According to the interviewee, they have proven to be particularly helpful not just in communicating meaningful insights to policy makers and subject matter experts. Rather, interactive maps and visualisations can contribute to a better understanding of the various community backgrounds and needs across Trafford by prompting new questions, thus working as a catalyst for more evidence-driven, progressive policy making.

In this process, the quality and cleanliness of data are highly important concerns for the lab. Critically, the lab depends on data being supplied from other departments and council units. This also implies that the lab indirectly depends on their data collection policies as well as more specific procedural details, such as data cleaning, formatting and storage. Given the strong reputation which the lab has earned since its inception, data accessibility and responsiveness of other unit on data releases is however mostly no problem.

4.4.1.5 Policies, laws and regulations

Two main laws impact the work of the Trafford Innovation and Intelligence Lab. Firstly, the UK's Data Protection Act, emerging from the EU Data Protection Directive, sets limitations not just on what the lab can do with data that it has gathered. More importantly, it also limits data sharing between the lab and some of its external partners. Since the lab produces almost no data on its own and, thus, depends largely on data sharing with other units, this can severely affect or complicate its work. Sharing granular health data for example is particularly difficult. This limits the potential to conduct more in-depth analysis on aspects related to poor health in Trafford, e.g. how educational achievement and health correlate.

Secondly, the Freedom of Information (FOI) Act is an important internal source for the lab to push for more data access. Usually, the lab does not make FOI requests to collect data from other units. However, the argument that data which such units might initially be reluctant to share could otherwise be retrieved via a FOI request, has already proven sufficient to convince those units to share data. Hence, the FOI also serves as an important instrument to facilitate intra-council data sharing. In Trafford's specific case, this appears as an important, distinct feature, resulting from the somewhat weak formal organisational position of the Trafford Innovation and Intelligence Lab. Because the lab has only been established as a data service unit for the council and because it is not backed by a targeted policy or strategy requiring other units to share data with it, the lab partly relies on external arguments such as the FOI Act to persuade other departments to share data with it.

4.4.2 OPPURTUNITIES, LIMITATIONS AND CHALLENGES IN DATA-DRIVEN DECISION MAKING

4.4.2.1 Current organisation

Organisational challenges stem specifically from the high fragmentation of some policy domains on the local government level. From the perspective of the interviewee, a coherent approach to gathering, processing and analysing data would require a joined up approach where all units involved in policy and service delivery collaborate across organisational boundaries. In practice, this is however hard to achieve – particularly in the health sector. Here, recent reforms with the abandoning of the Primary Care Trusts have also fragmented data management across a variety of organisations, most notably the Clinical Commissioning Groups (CCG) and the Clinical Support Units. This greatly increases the complexity of data sharing in health – a domain where the options for data analytics are justifiably limited due to personal data concerns.

The organisational fragmentation of local government also bears two more important challenges for Trafford: On the one hand, it implies that a wealth of more or less autonomous units and agencies need to be constantly convinced to share data. A mandatory data sharing or publication policy is not in place in Trafford. Hence, many involved persons might – consciously or not – impede a greater accessibility of systems.

On the other hand, fragmented units also frequently use their own IT systems to execute specific tasks or services. These systems are often not immediately compatible with each other or even completely closed, so that data cannot be exported from them. A recent example for the latter is Trafford's IT system to store information on blue badges for disabled parking. According to the interviewee, the current system is completely closed with no options to even export or extract data.

4.4.2.2 Decision making processes

One of the very basic challenges which Trafford continuously faces is to communicate relevant findings from data analytics to policy makers. The core question here is how the skills gap between data analysts and scientists as well as policy makers can be bridged effectively. Therefore, building connections between both groups is an important task. As part of this effort, it is particularly important to not present data-driven evidence as isolated insights, but relate them to other issues and topics which policy makers are familiar with and working on.

4.4.2.3 Types of data and data processing

Apart from the problems of siloed, proprietary data, big data also poses a specific opportunity and challenge to Trafford and local government in general. As mentioned in the previous section, technologies such as Natural Language Processing and text mining could help to substantially widen knowledge of citizens' concerns. The self-selection bias of social media data would however also likely require policymakers to carefully reflect results of such analyses before making decisions.

More refined data analytics based on larger, big data sets might additionally yield a better understanding of how civic needs differ in different places. Yet, individual boroughs and smaller towns are usually not big data producers. New models of data sharing or pooling between boroughs, e.g. in Greater Manchester might help to reach this level earlier.

4.4.2.4 Data accessibility and visualizations

While rigorous big data analytics might also enable new visualisation formats, structuring this data presents a more fundamental challenge. Implementing a standardised data catalogue, which ideally uses linked data standards, would help the council to both manage and publish data which is more consistent, query-able by default and discoverable. Hence, to scale up data analytics and data-driven decision making, drastically improved data management is required.

4.4.2.5 Policies, laws and regulations

As previously mentioned, the Data Protection Act as well as the FOI Act are the predominant regulations guiding the use of data in Trafford. Their impact can be both inhibiting (particularly in the case of sensitive health data) as well as enabling (where FOI requests are used as an argument to share data more quickly between council units).

4.4.3 SUMMARY AND CONCLUSIONS – TRAFFORD, ENGLAND

TRAFFORD, ENGLAND	
Respondents:	
Respondent	Head of Trafford Innovation and Intelligence Lab (Trafford Council unit to advance Trafford's use of data in decision making and service delivery)
Current organisation:	
Current situation	Organisation has been established as a cross-departmental service unit to facilitate data exploitation by functional units of Trafford Council. Strong acceptance and recognition as service provider after two years in service.
Limitations and challenges	Fragmentation of service units, particularly in policy domains such as health, also leads to scattered data management. This makes data acquisition and alignment more difficult, complicating the steps previous to any analysis.
Decision making processes:	
Current situation	Organisation is not involved directly in decision-making. However, its analyses have been used as a starting point for decisions and service improvements.
Limitations and challenges	Communicating relevant findings effectively to policy makers and subject matter experts. Bridging the skills gap between data analysts, technologists and policy makers.
Types of data and data processing:	
Current situation	Organisation uses a variety of open data (both council and beyond) and otherwise shared data.
Limitations and challenges	Data acquisition and management are substantial challenges to scale up current analytics. Organisational fragmentation leads to many

	stakeholders being involved in data sharing, which can impede quicker progress in data accessibility.
Types of data and data processing - Use of social media/social media data:	
Current situation	No use of social media until now. Concerns about self-selection bias and representativity of data exist within the lab and the council.
Limitations and challenges	Natural Language Processing and text mining could help to gain more refined insights on citizens' needs and demands. However, careful considerations need to be made to balance (assumed) needs of people not represented through such resources.
Data accessibility and visualizations:	
Current situation	Map based, interactive visualisations have emerged as the most important output of the lab. Data needs to be retrieved on a case by case basis from functional units and council departments.
Limitations and challenges	High organisational fragmentation of involved council units and third parties in various policy and service domains also leads to varying data collection policies and practices. Acquiring, aligning and cleaning relevant data can therefore pose a significant challenge even before analyses start.
Policies, laws and regulations:	
Current situation	Data Protection Act and Freedom of Information Act guide and sometimes limit not only the use, but also the sharing of data.
Limitations and challenges	Data Protection Act limits more effective data sharing, e.g. of health related data. Granularity of data is often not sufficient to conduct more refined, and thus useful, analytics. Freedom of Information Act is more seen as a facilitator to pressure other departments to share data with the lab proactively.
Outlook and critical issues:	
Outlook	Scaling up and refining current data analytics depends particularly on an improved data management as well as broader use cases. Data analytics should be more closely combined with efforts in organisational transformation to leverage wider impacts.
Critical issues	Data sharing, organisational fragmentation, data management and a general role out of data analytics appear as the most critical issues to progress data driven decision making and service delivery in Trafford.

4.5 VIENNA, AUSTRIA

4.5.1 DATA USAGE IN DECISION MAKING

The city of Vienna operates with a broad range of data sources ranging from statistical census data to geo-coded data, generated and automated data (e.g. traffic counts). Data sources and their applications are enormous, depending on the department and their tasks or projects. Vienna has a special threefold role given that it is a *city, county and municipality* at once and can operate with all data available without having local regulatory levels in between. For instance, in regards to city planning and urban development, Vienna has one of the largest data sets worldwide on housing and property management given the large social housing sector in the city.

Open Data in Vienna

The municipality of Vienna has taken a very proactive approach towards open data since 2011. As one interviewee explained it all started with so called “*low hanging fruits*”, explaining that at first data from the geographic information system that are already displayed in the official city map of Vienna were made open. However it has developed over time, with internal workshops with various departments once a year in order to generate ideas what data might be of interest and encourage more exchanges between different departments. Interestingly, the open data portal⁷ has also raised awareness within municipal departments of what type of data exists as they are often not aware what data other departments have. According to one interviewee there is slowly more engagement of departments to develop an open data culture. Still, oftentimes fears that failures or mistakes are made public and visible with opening data to the public are pertinent. An interviewee mentioned a great example of how Open Data can improve data quality: the ‘massive tree discovered in Vienna’⁸ where the height information for a tree was wrong, thus it appeared as if there was tree with 100m height on the city map. One user of this open data set feed this back to the respective department who was able to correct the mistake. One interviewee explained that opening up governmental data is a “*development process, it also shows that the principle of participation changes and thus alters the organisations – and changes within organisations are procedural and don’t usually happen abruptly.*”

Since 2011 the open government portal offers a broad range of open data, which can be uploaded by governmental-, non-governmental organisations and individuals. The site contains, among others, data on employment, health, traffic, tourism or leisure. A future goal for this site, as one interviewee mentioned is a more detailed description of metadata (some need to be filled out already), for instance already common standard regarding data of geographic information systems. Since the site contains such a broad array of data

⁷ www.data.gv.at

⁸ <https://open.wien.gv.at/site/riesenbaum-in-wien-entdeckt/>

and the city follows a very proactive approach towards making data public, there are rarely requests from the public for publishing data.

The 'Cooperation Open Government Data Austria' (founded in 2011) regularly organises public events and workshops, offering the open data community, i.e. those who make use of the open data, a platform to present their work (mostly Apps) and provide feedback. As one interviewee explained, the community who actually uses the data professionally to create apps and who participate in these events is a rather small.

4.5.2 OPPURTUNITIES, LIMITATIONS AND CHALLENGES IN DATA-DRIVEN DECISION MAKING

Using social media and big data in decision-making processes

Up until now social media data and analysis hasn't played a big role in urban decision-making processes in Vienna. However some attempts have been made, beside the official twitter account of the city of Vienna⁹, to use social media analysis in a few projects. One of these currently ongoing pilot projects in Vienna that work with social media data is 'Smarter Together'¹⁰, an EU project in the 11th district in Vienna, aiming to capture subjective feelings of an area through social media data.

Both interviewees explain several reasons that hamper a broadened usage of social media data so far. On the one hand in order for an analysis to make sense it needs a certain amount of data and a critical mass to participate, and on the other hand still methodological difficulties in text analysis, e.g. detecting irony etc. can cause contortions in the results. In addition some departments fear that using twitter as a communication and input channel for citizens will results in an overload of requests. Additionally, oftentimes more 'classical' face-to-face engagement methods appear to work better, as many projects within Vienna are often discussed more locally than on social media platforms. Social media use and analysis, as one interviewee suggests makes more sense if a project concerns the whole city (e.g. like redevelopment of one of the biggest shopping streets in Vienna, the Mariahilferstrasse). Such urban development projects might be more prone to using social media data. Despite social media being in focus of discussion within departments (especially the press and information service of the city) often, and manifold proof of concepts are being made, an interviewee stressed that up until now the available tools are finely granulated enough to achieve relevant results. Both interviewees are convinced that social media will be very important and will play a bigger role in the future of urban-decision making once more practical experiences are made and text analysis methods improve.

In regards to big data both interviewees think that big data analysis has a lot of potential, but solely basing decisions on (automated) big data in comparison to conscious political decisions is discussed rather critically. However, a combination of different data sources, e.g. in the context of traffic planning where automated data plays a bigger role, will play an important role in the future. In the context of urban traffic planning, one

⁹ https://twitter.com/stadt_wien

¹⁰ <https://www.wien.gv.at/bauen-wohnen/smartprojekt-simmering.html> (german) or

<http://www.ait.ac.at/departments/energy/smart-cities-and-regions/smart-cities-projects/smarter-together/?L=1> (English)

interviewee stresses the importance of looking at the core issue *“which has to be answered politically”*. Do I want a maximum of traffic members (cars) in a moving through the city in a minimum amount of time or do I want a minimum of cars to enhance the general quality of life?, the former will profit from big data in terms of automated censuses, whereas the latter will need other methods and political measures.

Public Engagement in Urban-Decision-Making Processes

Especially in regards to city planning and urban development projects, Vienna has multiple small and large-scale public engagement projects. Citizens are encouraged to actively participate in re-development projects of streets (e.g. Mariahilferstrasse), squares (e.g. Schwedenplatz) or to come forward with their own project ideas for their neighbourhood. An online city map called *‘Wien gestalten’*¹¹ (‘shape Vienna’) shows all ongoing participation projects in Vienna. Also in other sectors, like the IT-sector the public is regularly invited (on-and offline) to voice their opinions and ideas. An example project that took place from 2014-2015 is the *‘Digital Agenda for Vienna’*¹² where an innovative, citywide IT-strategy has been worked out through following a participatory approach that included both online and offline participation.

Visualizing Data

Current visualizations used by the municipality are found in the statistic yearbook and the official website which uses classic visualization methods, as *“technically there is not more possible at the moment”*. However, the ongoing Vienna Viz project discusses *“how can we make data visualizations nicely, e.g. Datenwaben”*¹³ (output from citizens using the Open Government Data Portal), data visualization which goes more in the direction of storytelling allowing people to have an image¹⁴. The current Open data portal offers open data and no visualizations yet – however also offering users methods to visualize data is currently being discussed within municipal departments. One interviewee mentioned the city of Zürich as a positive example of a municipality visualizing data¹⁵.

Legal Regulations

In regards to data usage and publication of municipal departments three legal frameworks at different levels apply: at the European level, the Austrian (national) level and the city of Vienna with its own data protection laws. Whereas both interviewees agree that laws regarding personal data are undisputable positive, given that not all data, e.g. personal health information, should be made public, in some areas especially regarding the e-government laws (‘Bereichsabgrenzungsgesetz’) the legal frame is very tight. One interviewee points out that one has to accept the existing laws, but sometimes the legal frame is too tight. According to one interviewee current laws hinder a more proactive approach of the city administration which is often expected

¹¹ <https://open.wien.gv.at/site/partizipation/>

¹² <https://www.digitaleagenda.wien/de/>

¹³ <https://www.data.gv.at/anwendungen/daten-waben/>

¹⁴ <http://de.slideshare.net/DigitalesWien/23-wiener-daten-wiener-gschichten> (please see visualization techniques from slide 15)

¹⁵ The interviewee suggested to look at their official twitter account: <https://twitter.com/stadtzuerich?lang=en>

by citizens, especially regarding a so called ‘non-stop-government’ where for instance citizens could get a push notification once their passport needs to be renewed.

4.5.3 SUMMARY AND CONCLUSIONS – VIENNA, AUSTRIA

VIENNA, AUSTRIA	
Respondents:	
Respondent 1	Spokeswoman of OGD (Open Government Data) Vienna, employee municipality of Vienna
Respondent 2	Director IT-Management, Municipality of Vienna
Current organisation:	
Current situation	Besides data managerial and administrative tasks, the IT-Management department is very active - internally and externally - in promoting open governmental data and initiatives around the issue, like the ‘digital agenda for Vienna’.
Limitations and challenges	Continuously organizing more awareness-raising workshops regarding positive effects and examples of opening up data and using new data sources, like social media, for other municipal departments.
Decision making processes/Public Engagement:	
Current situation	Vienna has multiple small and large-scale public engagement projects. Public engagement methods vary from more traditional offline (face-to-face, public forums etc.) to online participation (web forums, petition platform).
Limitations and challenges	The use of social media as a communication and input channel for citizens is rather small, but the use and new roles, e.g. social media coordinator is currently discussed within some municipal departments.
Types of data and data processing:	
Current situation	The city of Vienna works with multiple data sources ranging from census to geo-coded data, not all of them however have uniform description (e.g. meta data), and formats, depending on the data collection.
Limitations and challenges	Sometimes municipal departments are not aware of what data other departments have. The Open Data portal also had positive effects in regards to internal data sharing and exchange.
Types of data and data processing - Use of social media/social media data:	
Current situation	A broad range of ‘traditional’ data sources used, use of social media and big data is currently discussed.
Limitations and challenges	Social media use and analysis is currently piloted in some urban development projects, but still limited and not often used for decision-making processes so far.
Data accessibility and visualizations:	
Current situation	Data accessibility in terms of open data is very good, given the proactive approach of opening up data by the municipality of Vienna.
Limitations and challenges	Currently, future developments regarding the open data portal focus on also offering visualization methods and establishing more rules for describing meta data.

Policies, laws and regulations:	
Current situation	Legal frameworks apply at three levels: EU, national and the city of Vienna.
Limitations and challenges	Sometimes the legal framework, e.g. 'Bereichsabgrenzungsgesetz' (about (not) sharing personal data between departments) makes a more proactive non-stop-government approach difficult. Sometimes citizens expect a more proactive approach, e.g. receiving push notifications once a passport needs to be renewed.
Outlook and critical issues:	
Outlook	Future potential of using big data in decision-making processes discussed as positive and important, but possible not solely basing decisions on one data source.
Critical issues	Future use and embedding of new media sources like big data and social media data in current decision-making approaches.

5 REPORT CONCLUSIONS

5.1 STAKEHOLDER EVALUATION CONCLUSIONS

The purpose of this report has been to outline current strategies and main points on how data is used in decision making in selected European Cities and to evaluate the current state and possible outlooks for data-driven decision making. The conclusions are presented in each section below.

5.1.1 DATA MANAGEMENT, LIMITATIONS AND CHALLENGES

Most of the organisations interviewed are both managing and indeed advocating open data in various forms on a daily basis. Several of the organisations provide data and visualization for decision making both within and outside their cities and municipalities. There are also processes that include collecting, consolidating and promoting data for everyday administration and planning. The need for open data sources and knowledge of how to use social media data is perceived as a key factor. Limitations of data management are mainly related to divisions amongst organizational units. Fragmentation of service and municipality units leads to scattered data management and further to difficulties with data acquisition, data alignment and analysis. This could impede an efficient data-driven decision making. The challenges include gaining a better control of data, broadening the data available and continuously organising more awareness regarding positive effects of open data and other data sources.

5.1.2 DECISION MAKING PROCESSES/PUBLIC ENGAGEMENT

The data-driven decision making processes have both similarities and differences between cities. Several of the interviewed organisations support political and other units with data and visualizations. They describe themselves as not directly involved in decision making. However, the impact can be seen as indirect since several important decisions are based on credible data compilations and data analyses. Interests of citizens and public involvement are highlighted as important elements in the process. The forms and platforms for public participation differ. Face-to-face meetings, public forums, online participation mechanisms such as web forums and petition platforms are some examples. A major challenge is to find good ways to integrate big data sources and faster data without compromising the quality of the decision making. There is also a need for a developed understanding of professional skills on different levels, e.g. from shop floor level to management and strategic level. Various experts in data management, data analysis and data driven decision making tend to work in isolation from each other. The challenge is therefore to increase the communication between data analysts, technologists and policy makers. Social media is used only in limited form as a data source and communication platform in the cities. New professional roles, such as social media coordinators, can help to develop the use of external social media sources in municipal departments.

5.1.3 TYPES OF DATA AND DATA PROCESSING

The types of data used in cities vary from population data to different forms of spatial data. Geocoded data is emphasised as particularly valuable because of an increased production of maps and map services. Much of the multiple data sources used are internal and derived from the so-called reliable data producers and owners, such as governmental agencies and branches of government. The cities produce their own data but they are also dependent on external support and simple ways to work with data. For instance, consultants have significant roles to produce and retrieve data from external sources, and predetermined models and workflows are used in many cities to simplify data flows. There is also a strong desire and trend to publish and share as much open data as possible, which is especially promoted in urban areas like Copenhagen, Manchester and Vienna. As mentioned above, new data sources such as social media data are generally considered to be an uncertain source of information in decision making processes. Several respondents perceive that with the division of organisations, too many stakeholders being involved in data sharing and different responsibilities of various forms of data can impede the progress in data accessibility and data management. Sometimes municipal departments and units are not aware of what kind of data other stakeholders have. Therefore, open data portals can contribute to dissolve the fragmentation of organisations in regards to internal data sharing and exchange. A major challenge is also to employ new data sources in decision making without breaking any laws (see below). Another challenge includes an increased data acquisition and data management in order to improve existing analytics.

5.1.4 TYPES OF DATA AND DATA PROCESSING - USE OF SOCIAL MEDIA/SOCIAL MEDIA DATA

In relation to traditional data sources, the use of social media data in the cities is sparse. The discussions are primarily about how social media data and big data can be implemented in various work processes. In Malmö and Oxford, social media is considered as a convenient communication tool to e.g. inform citizens about decisions and measures, rather than a tool where strategic knowledge about the cities can be developed. Copenhagen has an active citizen panel that is surveyed several times a year in order to get a representative picture of citizen's views. In Vienna, the social media use and analysis are piloted in some urban development projects, but the implementation is still limited and not so frequently used in decision-making processes. The respondents are generally critical and aware of the shortcomings of social media data. There is an overall lack of trust in the quality of social media data, especially in comparison with traditional data sources, such as data from governmental agencies or other quality assessed data sources. Other critical issues concern how to read social media data or the lack of representativity of all groups of citizens in the data flow. A challenge is therefore to carefully consider and balance the representativeness of groups of citizens not represented in the data sources from social media. This can be done by collecting the information in other ways, e.g. by traditional face-to-face meetings, information meetings in different neighbourhoods, etc.

5.1.5 DATA ACCESSIBILITY AND VISUALISATIONS

As already stated, the accessibility of open data is good due to proactive approaches of opening up data. Data visualizations are used in a lot of ways for internal and external information and decisions. Data is visualised in different forms, such as tables, charts, cartograms and maps. Map based interactive visualisations have emerged as the one of the most important outputs used in all cities. Technical infrastructures and related applications for and creating and managing data and visualizations are usually well developed in cities. However, an identified limitation is the lack of time and knowledge among stakeholders to manage these applications and technical systems. Consequently, an organisational challenge is to increase the knowledge of how to visualize and redistribute data using applications and technical infrastructure already available. High organisational fragmentation often leads to varying data collection policies and practices. Thus, acquiring, structuring and cleaning data can pose a significant challenge even before analyses start. Another claim for a more quality-assured use of open data and relevant visualisation is to establish rules and procedures to formulate better metadata descriptions.

5.1.6 POLICIES, LAWS AND REGULATIONS

National laws on data protection, privacy and accessibility restrict and support how data can be shared and used in relation to decision making. Most of representatives of municipalities, units and councils from the cities are well aware of the legal regulations and they also act in accordance with the laws. Different acts such as the Data Protection Act and Freedom of Information Act in the UK or Personal Data Act in Sweden limits the possibilities of use and sharing of data. This includes in particular data that includes personal and sensitive information, such as health related data. Granularity of aggregation of data is often not sufficient to conduct more refined and useful analytics. Also legal frameworks such as 'Bereichsabgrenzungsgesetz' in Austria can hinder data exchanges as there are restrictions on data sharing between national departments. Differences between national laws make it difficult to share even open data sources between countries. One highlighted challenge to increase the use of data and still maintain control to ensure that data doesn't get misused due to laws on public access. Another challenge is to develop legal regulations that allow both businesses and individual citizens to share data in a controlled way.

5.2 OUTLOOK AND CRITICAL ISSUES

The following future items for an improved data-based decision were highlighted by the cities:

- Increase the knowledge of how organisations can use, process and analyse already available data sources;
- Increase the expertise in evidence and data-based decision making;
- Broaden the base of available/open data;
- Make better use of administrative data in local government;
- Increase the accuracy and trustworthiness of new data being employed and move from proof-of-concept to implementation;
- Scale up and refine current data analytics in combination with efforts in organisational transformation to leverage wider impacts;
- Highlight the future potential of using big data and multiple data sources in decision-making processes as something positive and important.

Some of critical points in the cities were:

- It seems difficult to combine large and fast new data sources with the prevailing laws and long decision-making processes such as urban planning processes;
- Several potential data users lack professional knowledge and understanding of new data sources;
- There is a need to implement better legal and technical means for the controlled sharing and visualisation of data;
- Data sharing, organisational division, data management and a general roll out of data analytics are all critical issues to progress data driven decision making and service in urban areas;
- A fear of using social media and social media data is the risks of excluding certain groups of the population and potentially skewing the results.

- Finally, open data and social media data should not be considered the main source for decision making, rather as a tool supporting the current processed. A critical challenge is thus to use and embed these new sources in the current decision-making approaches.

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ANNEX1

Glossary of Terms

API

An Application Programming Interface (API) is an abstraction implemented in software that defines how others should make use of a software package such as a library or other reusable program. APIs are used to provide developers access to data and functionality from a given system.

Data

A value or set of values representing a specific concept or concepts. Data become “information” when analysed and possibly combined with other data in order to extract meaning, and to provide context. The meaning of data can vary depending on its context. Data includes all data. It includes, but is not limited to, 1) geospatial data 2) unstructured data, 3) structured data, etc.

Big data

Big data is high-volume, high-velocity and high-variety of information and data that demands cost-effective and innovative forms of information processing to enhance insight and decision-making. Where the three characteristics of high volume, velocity and variety, further describe the nature of all the available data (e.g. structured, unstructured and Geospatial) and information, from which concepts, context and meaning can be derived to provide insights and improved decision-making.

Dataset

A dataset is an organised collection of data. The most basic representation of a dataset is data elements presented in tabular form. Each column represents a particular variable. Each row corresponds to a given value of that column's variable. A dataset may also present information in a variety of non-tabular formats, such as an extended mark-up language (XML) file, a geospatial data file, or an image file, etc.

Open Data

A piece of data is open if anyone is free to use, reuse, and redistribute it - subject only, at most, to the requirement to attribute and/or share-alike.

Open Government Data

Open data produced by the government. This is generally accepted to be data gathered during the course of business as usual activities which do not identify individuals or breach commercial sensitivity.

ANNEX 2

Structure for interviews

Setting the scene

- Short presentation of the UrbanData2Decide project

Urban decision makers are nowadays faced with both unprecedented challenges as well as new opportunities as the environment around them grows ever more complex. Out of the readily available “sea of information”, unfortunately, some sources potentially important to decision-making have so far remained largely untapped. The UrbanData2Decide project therefore aims to extract and process information from two rich sources, namely public social media and open data libraries. This information, combined with advice from expert panels, will support local governments towards a holistic, sustainable and well-founded decision-making process which takes into account the views and perspectives of all relevant stakeholders.

- Explain the purpose of the interview
 - The aim of the interview is to examine stakeholders’ views on data-driven decision-making processes
- The interview will be divided into two parts
 - Current practices in data-driven decision-making
 - Opportunities, limitations and challenges in data-driven decision-making

Current practices in data-driven decision-making

1. What is your profession and which responsibilities do you have in your organisation?
2. Which data sources do you employ in your work and in your organisation in general?
 - Describe one or two scenarios in which these data are particularly helpful
3. What kind of strategies and policies do you have for data collection and usage?
 - Automated or manual data collection?
4. How do you visualize data today and when do you find visualizations most helpful?
5. What kind of decision making processes are you involved in where you use different types of data?
6. How do you include the public opinion in your data and in your decision making processes?
7. In what ways do you see the analysis of Big Data and/or Social Media impacting your decision making processes?
 - Focus on mixed data approaches
8. Which policies or laws on data privacy and data protection are you aware of and in what ways do these regulations support or limit your work with data?

Opportunities, limitations and challenges in data-driven decision-making

1. Are you experiencing any limitations when you collect and share data within your organisation?
2. Are you experiencing any limitations when you collect and share data publically?
 - E.g. releasing open data sets.
3. Where do you see future potential in increasing the use of Big Data and social media data?
4. Where you see the future challenges when using Big Data and Social Media data?
5. Any benefit or challenge that you would like to add?

End of interview